

CLAIMS

1. A discharge lamp ballast for operating a discharge lamp composed of an arc tube and an envelope surrounding said arc tube, said ballast comprising:
 - an igniter that provides a high frequency ignition voltage in order to develop an arc in said arc tube for starting said discharge lamp;
 - an AC power unit that provides a low frequency AC output power to said arc tube for operating the discharge lamp after said lamp is ignited;,,
 - a detector that examines an electric characteristic of an arc discharge occurring outside of said arc tube after said discharge lamp is ignited, said detector analyzing said electrical characteristic to determine an abnormal discharge when there is a critical change in said electrical characteristic, and
 - a limiter that limits said AC output power from said power generator in response to the determination of said abnormal discharge.
2. The ballast as set forth in claim 1, wherein
said detector is configured to examine said electric characteristic of said arc discharge occurring within said envelope.
3. The discharge lamp ballast as set forth in claim 2, wherein
said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,

said lamp monitor monitoring said lamp parameter once within each of positive and negative half-cycles of said AC output power,

said analyzer comparing said lamp parameter in each of said positive and negative half-cycles with a predetermined threshold, and incrementing an error count when said lamp parameter exceeds said threshold, and

said analyzer determining said abnormal discharge when said error count exceeds a predetermined count.

4. The discharge lamp ballast as set forth in claim 2, wherein

said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,

said lamp monitor monitoring said lamp parameter once within at least one of positive and negative half-cycles of said AC output power,

said analyzer comparing said lamp parameter with a predetermined threshold to give a flag when said lamp parameter exceeds said threshold,

said analyzer comparing the next lamp parameter with said threshold and incrementing an error count when said next lamp parameter does not exceed said threshold and when said flag has been set with regard to the previous lamp parameter, and

said analyzer determining said abnormal discharge when said error count exceeds a predetermined count.

5. The discharge lamp ballast as set forth in claim 2, wherein

said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,

said lamp monitor monitoring said lamp parameter once within each of positive and negative half-cycles of said AC output power,

said an analyzer designating the lamp parameter monitored in each of said positive and negative half-cycles as a first lamp parameter, and designating the lamp parameter monitored in the successive one of said positive and negative half-cycles as a second lamp parameter,

said analyzer comparing said first lamp parameter with a predetermined first threshold to give a first flag when said first lamp parameter exceeds said first threshold, and comparing said second lamp parameter with a predetermined second threshold to give a second flag when said second lamp parameter exceeds said second threshold,

said analyzer comparing the next first lamp parameter with said first threshold and incrementing a first error count when said next first lamp parameter does not exceed said first threshold and when said first flag has been set with regard to the previous first lamp parameter,

said analyzer comparing the next second lamp parameter with said second threshold and incrementing a second error count when said next second lamp parameter does not exceed said second threshold and when the second flag has been set with regard to the previous second lamp parameter,

said analyzer determining said abnormal discharge either when said first error count exceeds a predetermined count or when said second error count exceeds a predetermined count.

6. The discharge lamp ballast as set forth in claim 2, wherein

 said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,
 said analyzer comparing said lamp parameter in each of said positive and negative half-cycles with a first threshold and also with a second threshold which is lower than said first threshold,
 said analyzer incrementing a first error count when said lamp parameter is greater than said first threshold, and incrementing a second error count when said lamp parameter is lower than said second threshold, and
 said analyzer determining said abnormal discharge either when said first error count exceeds a first value or when said second error count exceeds a second value,

7. The discharge lamp ballast as set forth in claim 2, wherein

 said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,
 said lamp monitor monitoring said lamp parameter once within each of positive and negative half-cycles of said AC output power,
 said an analyzer designating the lamp parameter monitored in each of said positive and negative half-cycles as a first lamp parameter, and designating the

lamp parameter monitored in the successive one of said positive and negative half-cycles as a second lamp parameter,

 said analyzer obtaining a difference between said first lamp parameter and said second lamp parameter, and incrementing an error count when said difference exceeds a predetermined threshold,

 said analyzer determining said abnormal discharge when said error count exceeds a predetermined count.

8. The discharge lamp ballast as set forth in claim 2, wherein

 said detector includes a lamp monitor for monitoring a lamp parameter which is one of a lamp voltage and a lamp current being applied to said discharge lamp, and an analyzer for determination of said abnormal discharge,

 said lamp monitor monitoring said lamp voltage once within each of positive and negative half-cycles of said AC output power,

 said analyzer designating the lamp parameter monitored in each of said positive and negative half-cycles as a first lamp parameter, and designating the lamp parameter monitored in the successive one of said positive and negative half-cycles as a second lamp parameter,

 said analyzer comparing said first lamp parameter with said second lamp parameter, and incrementing an error count when said first lamp parameter is greater than said second lamp parameter multiplied by a predetermined value,

 said analyzer determining said abnormal discharge when said error count exceeds a predetermined count.

9. The discharge lamp ballast as set forth in claim 2, wherein
said detector includes a lamp monitor for monitoring a lamp parameter which
is one of a lamp voltage and a lamp current being applied to said discharge lamp,
and an analyzer for determination of said abnormal discharge,
said lamp monitor monitoring said lamp parameter once within each of
positive and negative half-cycles of said AC output power,
said an analyzer designating the lamp parameter monitored in each of said
positive and negative half-cycles as a first lamp parameter, and designating the
lamp parameter monitored in the successive one of said positive and negative
half-cycles cycle as a second lamp parameter,
 - a) said analyzer having a first logic that compares each of said first and second
lamp parameters with a predetermined threshold and increments an error
count when the lamp parameter exceeds said threshold, said first logic
issuing a first alarm when said error count exceeds a predetermined count,
 - b) said analyzer having a second logic that compares one of said first and
second lamp parameters with a predetermined threshold to set a flag when
said one of said first and second lamp parameters exceeds said threshold,
said second logic comparing the next corresponding one of said first and
second lamp parameters with said threshold to increment an error count
when said next corresponding one of said first and second lamp parameters
does not exceed said threshold and when the flag has been set with regard
to the previous corresponding one of said first and second lamp parameters,
said second logic issuing a second alarm when said error count exceeds a
predetermined count;
 - c) said analyzer having a third logic that compares one of said first and second

- lamp parameters with a first threshold and also with a second threshold which is lower than said threshold, said third logic incrementing a first error count when said one of the first and second lamp parameters is greater than said first threshold, and incrementing a second error count when said one of the first and second lamp parameters is lower than said second threshold, said third logic issuing a third alarm either when said first error count exceeds a predetermined count or when said second error count exceeds a predetermined count,
- d) said analyzer having a fourth logic that obtains a difference between said first lamp parameter and said second lamp parameter and increments an error count when said difference exceeds a predetermined threshold, said fourth logic issuing a fourth alarm when said error count exceeds a predetermined count,
 - e) said analyzer having a fifth logic that compares said first lamp parameter with said second parameter and increments an error count when said first lamp parameter is greater than said second lamp parameter multiplied by a predetermined value, said fifth logic issuing a second alarm when said error count exceeds a predetermined count,
said analyzer determining said abnormal discharge when any one of said first, second, third, fourth, and fifth alarm is issued.

10. The discharge lamp ballast as set forth in any one of claims 3 to 9, wherein said detector includes an initializer that disables said analyzer until the said positive and negative half-cycles repeat a predetermined number of times.